POLYGYRISCUS VIRGINIANUS (BURCH, 1947) A HELICODISCID LAND SNAIL (PULMONATA: HELICODISCIDAE)

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ABSTRACT

Dissection and scanning electron microscope studies of the Virginia land snail, Polygyriscus virginianus *(Burch, 1947), show that this species, previously associated with either* Polygyra *or* Helicodiscus, *is related to* Helicodiscus *and* Stenopylis. *The family group Helicodiscidae is redefined and differences from possibly related family units noted.*

INTRODUCTION

Shortly after it was described as *Polygyra virginiana* P. R. Burch (1947), Pilsbry (1948: 1097-1098, fig. 584) proposed a new subgenus, *Polygyriscus*, and stated "This very peculiar snail is probably not nearly related to *Polygyra*, but is left in that family temporarily." Solem (1957: 9) raised *Polygyriscus* to generic rank and placed it in the endodontid subfamily, Helicodiscinae. J. B. Burch (1962: 148, fig. 363) presented new figures and Hubricht (1972: 16-17), who had collected some living specimens, also suggested that it was related to *Helicodiscus* on the basis of the spiral epidermal fringes seen on the juvenile and some adult shells. The only known locality for this species, near Radford, Virginia, was visited by the author in 1974, but only one dead fragment observed.

Through the courtesy of Leslie Hubricht, it was possible to dissect and illustrate the anatomy (Field Museum of Natural History 173197) and to illustrate a shell (FMNH 173234) with periostracal fringes intact. I am indebted to Carole W. Christman for the drawings in Fig. 1 and to Elizabeth Liebman who prepared the drawings in Fig. 2 with support from Office of Endangered Species Contract No. 14-16-0008-764. The scanning electron microscope photographs (Figs. 3-8) were taken in the course of cooperative research with the American Dental Association Research Institute. The assistance of John Lenke and George Najarian is gratefully acknowledged. The prints were prepared by Fred Huysmans.

This is one of the rarest and most unusual North American land snails. Recommendations have been made to the Office of Endangered Species (OES) that *Polygyriscus virginianus* be declared an endangered species and given protection against both collecting and habitat disturbance. This paper, publication of which is supported by the Office of Endangered Species, was prepared as one result of contract work on potentially endangered species of Eastern North America. I am grateful to the OES staff, particularly Marc Imlay, for their support and encouragement.

SHELL STRUCTURE AND FORM

The presence of deciduous periostracal spiral fringes (Fig. 2 *a*) is characteristic of *Helicodiscus* (see Pilsbry, 1948: figs. 339, 341, 342, 344) and *Stenopylis* (see Solem, 1957: 11, fig. 4). In *Polygyriscus* there are remnants of 8 to 10 such spiral rows on the body whorl above the periphery. Those on the shell base usually are completely eroded. The fringes have a very characteristic "comb-like" pattern (Fig. 2 *c*) when viewed under high magnification. In *Helicodiscus, s. s.*, and *Stenopylis* the rows are more numerous and lower, while in *Helicodiscus (Hebetodiscus)* the fringes are absent.

In pattern of whorl coiling and umbilical shape, *Polygyriscus* (Fig. 2 *a, b*) is the same as both *Helicodiscus* and *Stenopylis*. The genera differ in apertural armature and lip edge characters. In *Helicodiscus* (see Pilsbry, 1948: 622-640) the lip is not reflected and simple,

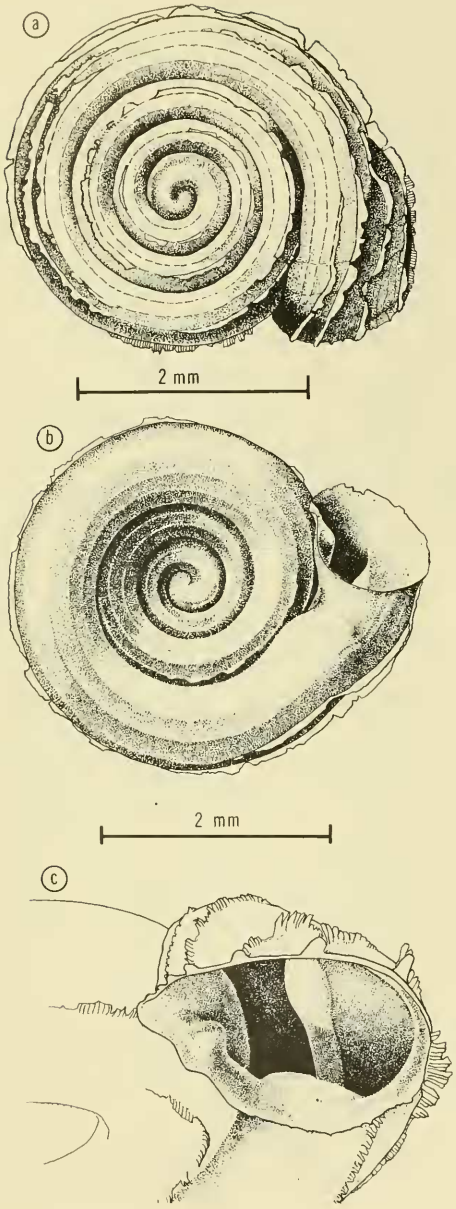
while there are usually pairs of tubercles deposited at intervals on the parietal and/or palatal walls (see Hubricht, 1975: 2-4). In *Stenopylis* the outer lip is thickened and reflected, the parietal callus is raised and curved outwards so that it forms a crescent narrowing the aperture, and there are an internal lamellar extension on the parietal wall and a separate parietal nodule (see Solem, 1957: 11, fig. 1 *c*). In *Polygyriscus* the last fraction of the body whorl is strongly deflected downwards (Fig. 2 *c*) and it is narrowed by the deflection. There is a strong inward growth of the basal margin (Fig. 2 *b*) and an equivalent invagination of the parietal wall that produces either a nodular effect (Fig. 2 *c*) or, in the case of actual parietal wall detachment (Pilsbry, 1948: 1098, fig. 584), this becomes a U-shaped margin. In addition to the apertural constriction, there are two barriers present: a transverse ridge just inside the basal lip that was first reported by Hubricht (1972), and a long barrier on the upper palatal wall (Fig. 2 *c*) that is moderately recessed (Fig. 2 *b*). The pattern of apertural constriction is different from that seen in *Stenopylis*, and the barrier positions and shapes are very different from the patterns found in *Helicodiscus*. While the three genera share a common growth pattern and basic shell sculpture, they are quite distinct in apertural form and barrier details.

FIG. 1. *Anatomy of* Polygyriscus virginianus *(P. R. Burch):* **a,** *dissected genitalia showing origins and insertions of structures;* **b,** *interior of penis showing verge (PV) and major pilasters (PP);* **c,** *pallial region. Scale lines equal 1 mm. Field Museum of Natural History no. 173197. Other abbreviations explained in text.*

GROSS ANATOMY

All available data on the anatomy of *Helicodiscus* are summarized or repeated in Pilsbry (1948). Rather than presenting a formal description of the anatomy of *Polygyriscus*, I provide comparative remarks and emphasize the features in which they differ from the other major groups of endodontoid land snails. The pallial complex (Fig. 1 *c*) is exactly comparable to that of the Endodontidae, in having a weak rectal arm to the kidney (K) and a slightly reflected ureter (KD) that opens posteriorly. There is no differentiated urinary groove leading to the pneumostome. The heart (H), intestine (I), hindgut (HG), unbranched principal pulmonary vein (HV), anus (A), and mantle collar (MC) are exactly as in *Helicodiscus* (Pilsbry, 1948: 628, fig. 340 *b*) and agree with the Endodontidae. The Punctidae and Charopidae differ in usually having a completely closed secondary ureter and often a strongly bilobed kidney, while the Discidae have a very simple triangular kidney that does not reach the hindgut at any point and a complete secondary ureter.

Differences in the genitalia are fundamental and obvious at first inspection. Both



Helicodiscus (Pilsbry, 1948: 624, fig. 338) and *Polygyriscus* (Fig. 1 *a*) have a long, unbranched ovotestis (G) that occupies about one whorl in the upper digestive gland. In most Punctidae and Charopidae there are one or two main lobes to the ovotestis that lie pointing apicad. Each of them is split into several fingerlike subsidiary lobes. In larger species the number and orientation of these lobes can change, but the basic cluster pattern is preserved. In the Endodontidae the ovotestis contains many follicles strung in a line along a single duct, with the follicles angled apicad from the shell axis, rather than pointing directly apicad. In the Discidae, there are a number of multibranched follicle bundles at spaced intervals along a duct. These bundles lie nearly perpendicular to the shell axis. All of these families except the Endodontidae agree in having the prostate-uterus at least partly fused with a common lumen, while the Endodontidae have these ducts completely separate for their entire length.

Family level differences in the terminal genitalia will be discussed elsewhere, since confusing patterns of convergent evolution make simple definitions impossible without first presenting considerable illustrative material. The several families do show distinct differences in this region, but surveys of these differences are beyond the scope of this paper.

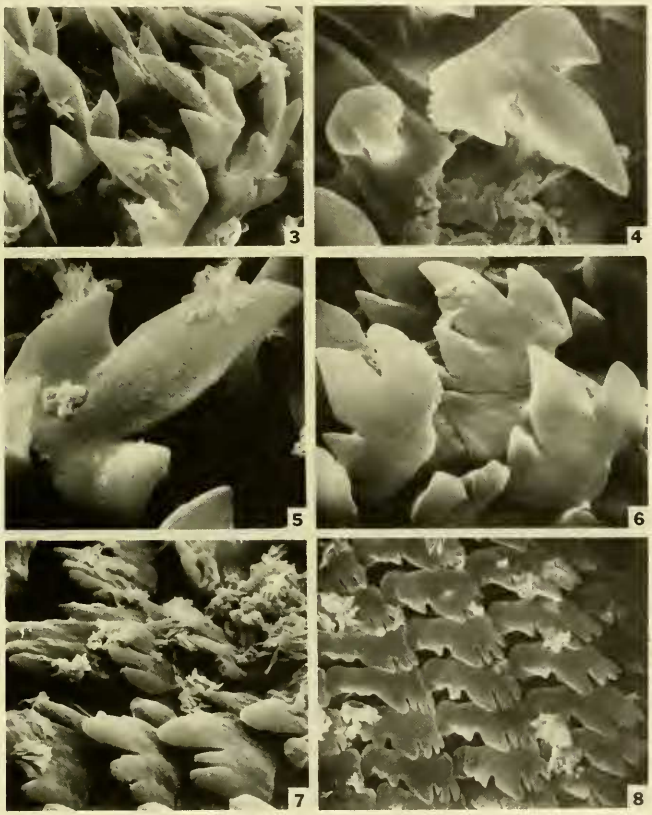
The talon in the Charopidae and Punctidae has a globose head on a short shaft; in the Endodontidae it is an elongately oval expansion on a usually longer shaft; in the Discidae it is a tripartite complex structure (Pilsbry, 1948: 568, fig. 304, D) very similar externally at least to that found in the Succineidae; and in both *Helicodiscus* (Pilsbry, 1948: 624, figs. 338, A, C, D) and *Polygyriscus* (fig. 1 *a*) the talon (GT) is a very long, often recurved shaft with only a slightly enlarged head.

The hermaphroditic duct (GD), albumen gland (GG), carrefour (X), uterine area (UT) of the prostate-uterine tract, free oviduct (UV), vagina

FIG. 2. *Shell of* Polygyriscus virginianus *(P. R. Burch). Field Museum of Natural History no. 173234. Scale lines equal 2 mm.*

(V), spermatheca (S), atrium (Y), and prostate (not shown, in fig. 2) of *Polygyriscus* are as in *Helicodiscus*. Both *Helicodiscus* and *Polygyriscus* have a muscle, the epiphallic retractor (fig. 2 *a*, *b*, EM), that has no analog in the other endodontoid families. The presence of a well differentiated epiphallus (E) is a characteristic of the Helicodiscidae and most Charopidae, but this structure usually is absent in the Endodontidae, Discidae, and Punctidae. The penis retractor muscle (PR) originates from the diaphragm and inserts on the penis-epiphallus junction, as in many endodontoid taxa.

The penis of *Polygyriscus* (fig. 2 *a*, P) is short, and internally (fig. 2 *b*) has an apical verge (PV) with subterminal epiphallic pore



FIGS. 3–8. *Radula of* Polygyriscus virginianus *(P. R. Bureh). Field Museum of Natural History no. 173197.* FIG. 3. *Central (lower left) and early lateral teeth. 2550×* FIG. 4. *Central and first lateral tooth. 3950×.* FIG. 5. *Third lateral tooth on left side of radula. 6000×.* FIG. 6. *Early marginal teeth from right side of radula. 4325×.* FIG. 7. *Mid-marginal teeth from left side of radula. 4225×.* FIG. 8. *Outer marginal teeth from left side of radula. 2375×.*

(EP) and two high, irregular pilasters (PP) in the lower two-thirds of the chamber. This differs markedly from the penis of *Helicodiscus parallelus* (Say, 1921) (see Pilsbry, 1948: 628, fig. 340, a), where the epiphallus opens through a small valve and there are glandular linings to the wall, but no pilasters present. Within the Charopidae and Endodontidae, differences of this magnitude are indicative of generic separation and these structural differences alone are sufficient to warrant separating *Helicodiscus* and *Polygyriscus*.

RADULAR STRUCTURE

The Punctidae have a radula in which there is no distinction between lateral and marginal teeth, but all the side teeth have a bicuspid structure with minute accessory cusps (Pilsbry, 1948: 642, fig. 349, d). The Charopidae basically have tricuspid centrals and laterals, although this situation is secondarily modified in many taxa. The Endodontidae have a tricuspid, large central, and bicuspid laterals (for example, see Solem 1973: figs. 5-8, 13-14). The Discidae agree in the bicuspid nature of the lateral teeth, but their structure differs from that found in the Endodontidae (Solem, unpublished).

The radula of *Helicodiscus* (Pilsbry, 1948: 623, fig. 337, a, p. 624, fig. 338, B) has a minute, tricuspid central tooth, large tricuspid laterals, and multicuspid marginals. The only note on the radula of *Stenopylis* (Hedley, 1896: 221, fig. C) showed tricuspid lateral teeth and marginals. Hedley "failed to distinguish the dentition as clearly as I wished" and probably overlooked the minute central tooth. In addition, Hedley referred to the marginals as "serrated", although they are drawn as tricuspid.

The radula of *Polygyriscus* (figs. 3-8) is of the helicodiscid type. The central tooth (lower left of fig. 3 and left third of fig. 4) has relatively large ectocones and a small mesocone. The basal plate is far longer than the cusps and the tooth itself is much smaller than the first lateral (fig. 4). Early laterals (figs. 3, 4) are tricuspid with the ectocone and endocone equal in size (fig. 4). The mesocone is long and tapering, with all three cusps elevated at about the same angle (fig. 3). By the third lateral, the endocone has become much larger than the ectocone (fig. 5). The fourth lateral (fig. 6) or first marginal tooth, depending on how they are defined, shows reduction in mesoconal size, a change in tooth angling, the beginning of endoconal splitting, and an unusual situation to the anterior margin on the endoconal side (right side in figure). Seen from a different angle (fig. 7), the mid-marginal teeth show splitting of both ectocone and endocone, with continued reduction in mesoconal size and a change in angle of tooth elevation. Outermost marginal teeth (fig. 8) are short and broad, with the mesocone barely larger than the split side cusps and the ectocone greatly reduced in size. There are thus three or four lateral teeth and six or seven marginal teeth on each side of the central tooth. They are virtually identical in structure to the teeth of *Helicodiscus*.

AFFINITIES OF *POLYGYRISCUS*

Polygyriscus is clearly related to *Helicodiscus* on the basis of shell form, sculpture, and apertural features; pallial region organization; gross genitalia; and radular features. *Polygyriscus* differs from *Helicodiscus* in possessing two prominent barriers in the shell aperture, having the aperture narrowed, deflected, and often detached when adult; having a penial verge and two prominent pilasters; and in having a much shorter pallial region. The suggestions of Solem (1957) and Hubricht (1972) that *Polygyriscus* is not a polygyrid, but a helicodiscid land snail are confirmed by these dissections.

The subfamily unit Helicodiscinae was credited to Pilsbry in a paper by H. B. Baker (1927: 226, 230). It was defined on the basis of kidney position, with *Helicodiscus*, *Radiodiscus*, and *Chanomphalus* included. Thiele (1931: 568-569) and Pilsbry (1948: 622-640) excluded *Radiodiscus* and defined the subfamily on the basis of the ovotestis, shell coiling, and radula. On the basis of studies on Pacific Island and Austro-Zelandic endodontoid snails (Solem, unpublished), I consider that *Helicodiscus*, *Stenopylis*, and *Polygyriscus* form a sharply defined family unit within the endodontoid complex. The questions of phyletic relationships to the other families and the exact divisions that will be recognized within other family units are beyond the scope of this paper. It is

desirable to offer the following emended characterization of the Helicodiscidae.

Family Helicodiscidae Pilsbry, 1927

Shell under 5 mm in diameter, consisting of flatly coiled whorls, few in number, that do not increase rapidly in size. Umbilicus widely open, shallow. Sculpture of spiral ridges, usually deciduous, reduced in some taxa. Aperture normally with barriers or nodules, sometimes deflected and/or thickened when adult. Pallial region with kidney reaching hindgut, a slight rectal extension, ureter opening next to hindgut at posterior of pallial cavity. Ovotestis a single lobe, talon very elongated and without expanded head. Prostate and uterus apparently united into a spermoviduct. Epiphallus large and with a separate retractor muscle. Penial retractor muscle originating from diaphragm. Penis with or without verge and pilasters. Radula with very small, tricuspid rachidian tooth, three or four tricuspid laterals, and several marginals that become shortened, broadened, and multicuspid near the outer edge of the radula.

The three genera included are *Helicodiscus* Morse, 1864 (plus the subgenus *Hebetodiscus* H. B. Baker, 1929 and the section *Pseudiscus* Morrison, 1942), *Polygyriscus* Pilsbry, 1948, and *Stenopylis* Fulton, 1914 (=*Coarctatio* Haas, 1945). I consider that *Chanomphalus* Strebel & Pfeffer, 1880 and *Radiodiscus* Pilsbry & Ferriss, 1906 belong to the charopid complex and are not related to *Helicodiscus*. Their exact affinities are still uncertain.

Helicodiscus is known from Jamaica, Cuba, Northern Mexico, and much of Eastern North America, with one species in the Columbia River drainage, but the genus is absent from California. *Polygyriscus* is restricted to a single locality in Virginia. *Stenopylis* has a wide and unusual distribution, extending from the Philippines and Indonesia to the Solomon Islands, Queensland, the MacDonnell and Krichauff mountains in Central Australia, and northern areas of Western Australia (Solem, 1957: 9-11 and unpublished). There is only one species, which has been described several times, most recently from Bach-Long-Vi or Nightingale Island in the Gulf of Tonkin (Saurin, 1960, as *Microphyura nightingali;* see Solem, 1957 for earlier synonymy). It has not, to my knowledge, been collected on the Asian mainland.

The family units of the endodontoid complex, which are classified in the superfamily Arionacea, are, in the order of their description, Punctidae Morse, 1864; Charopidae Hutton, 1884; Endodontidae Pilsbry, 1895; Helicodiscidae Pilsbry, 1927; and Discidae Thiele, 1931. While a total of 19 family level names have been proposed for members of this complex (Solem, In Press), probably all of these can be grouped into the above categories. The most obvious anatomical differences from the Helicodiscidae have been covered in the discussion of structures found in *Polygyriscus*. Shell differences are more subtle and will be reviewed elsewhere.

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THE MARINE COMMENSAL GASTROPOD, *CALEDONIELLA MONTROUZIERI* (PROSOBRANCHIA: HIPPONICACEA) IN THAILAND

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R. L. Caldwell, University of California, Berkeley, and H. Dingle, University of Iowa, deposited 9 specimens of the crustacean, *Gonodactylus viridis* Serene, 1954[1], in the collection of Mollusks, each infested with two specimens of *Caledoniella montrouzieri* (Souverbie) (Rosewater, 1969). Caldwell and Dingle, who collected the *Gonodactylus* in Phuket, Thailand, stated that about 25% of the stomatopods were infested (pers. comm.). In all cases the location of the snails was exactly as previously described: males were between the periopods near the ventral posterior end of the thorax, females between the 4th and 5th pleopods on the ventral posterior abdomen. The pleopods were liberally covered with the snails' egg capsules.

This discovery adds the following new information to that summarized in my earlier paper: the sexual dimorphism apparent in the male and female shells illustrated on plate 55 of that paper is confirmed, females being larger and helicoid, males are smaller and cap-shaped; there is strong position preference in the two sexes; an additional stomatopod species is infested in addition to the 3 known previously, *G. chiragra*, *G. platysoma* and *G. smithii;* a new country is recorded as domicile for *C. montrouzieri*, although Phuket, Thailand, is less than 500 miles from the Andaman Islands where it was previously collected.

[1] R. B. Manning identified the stomatopod.

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